Data Quality Objectives (DQOs) define the type, quality, quantity, purpose, and intended uses of data to be collected. In brief, the DQO process typically follows a seven-step procedure, as follows:

1. State the problem

Historic emissions from the Trail smelting facility in Trail, BC have included metal-enriched particulates and aerosols. These airborne particles were deposited at varying distances from the smelter and became incorporated into the soil horizon. Various studies and soil sampling activities conducted in the Columbia River Valley corridor south of the U.S.-Canadian border (Hart Crowser 2013; Shannon & Wilson, Inc. 2011) have demonstrated the presence of elevated heavy metal concentrations in the upper horizons of minimally disturbed soils. Elevated metal concentrations also have been mapped in surface soils collected by Canadian investigators between Trail, BC and the U.S.-Canadian border (Goodarzi, Sanei et al. 2002, Goodarzi, Sanei et al. 2006; Intrinsic et al., 2011).

A 2007 Cantox Environmental Inc. memorandum to Teck Cominco Metals Ltd titled *Potential Chemicals of Concern for Terrestrial Wildlife in the Trail Wide-area Site ERA* states that "metal concentrations of antimony, arsenic, cadmium, copper, lead, mercury and zinc in soil are related to past smelter activities." The highest metal concentrations within soils at the Upper Columbia River (UCR) site in areas close to the U.S.-Canadian border appear to occur primarily along the side slopes of the Columbia River Valley and its associated tributaries (Hart Crowser, 2013).

Uncertainty currently exists over the areal extent of contamination and potential exposure point concentrations for Washington State residents living within the UCR Valley, including subsistence farmers and Tribal citizens. EPA is planning a focused rural residential investigation of the northernmost reaches of the UCR valley (north of the town of Northport to the U.S.-Canadian border) to assess potential risks to existing residents from exposure to metal contaminated soils. This residential soil investigation will be coordinated with and complement other soil sampling planned for the Upper Columbia RI/FS Soil Investigation (EPA Technical Team for the Upper Columbia River RI/FS 2012, Exponent, HydroQual et al. 2013).

2. Identify the goal of the study

Sample surface soil in locations where there is a high potential for exposure by residents, especially young children. Young children and subsistence users are most susceptible to possible metal exposure via direct soil ingestion.

Principal Human Heath Risk Study Question:

Do lead and arsenic concentrations (and possibly other metals) in the fine-grained fraction of soils from rural residential parcels and tribal allotment properties pose a potential risk to human health, particularly children who live within the current area of study (Figure 1)?

3. Identify information inputs

- EPA Technical Team Level of Effort (LOE) for Sampling and Analysis of Soil in the Upper Columbia River Basin (Soil LOE) (EPA Technical Team for the Upper Columbia River RI/FS 2012)

- DRAFT - Upper Columbia River Soil Study Quality Assurance Project Plan (Exponent, HydroQual et al. 2013)

- Land use data from county tax assessor maps and the Confederated Tribes of the Colville Indian Reservation (CCT)

- Proximity relative to Trail, BC and the Columbia River

- Assistance from CCT, local government, community groups, school district, property owners, and residents to identify residential land use and obtain access to target properties

- Human health preliminary remedial goals for lead and arsenic (a more thorough list of contaminants of concern and preliminary remedial goals will be in the sampling plan):

  400 mg/kg lead

  10 mg/kg arsenic (based on current background estimates)

- Previous sampling data from Teck, British Columbia, Trail, Canadian Ministry of the Environment, Health Canada, EPA (Northport soil data), and Washington State Department of Ecology (Hart Crowser 2013), U.S. Customs and Border Protection (Boundary Land Port of Entry)

Data to be collected will incorporate the following objectives and considerations:

- Inferred exposure areas based on communications with residents, accessibility of soil, gardens, pastures, or other visual information at each property.

- Washington Department of Ecology residential sampling guidance for area-wide contamination.

- Field portable XRF may be used to refine sampling approach and to avoid areas contaminated with lead based paint.

- Estimates of bioavailability based on in-vitro bioaccessibility (U.S. Environmental Protection Agency 2007)

4. Define the boundaries (in space and time) of the study

UCR Conceptual Site Model

Available soils data indicate that transport of the metals from the Trail Smelter into the UCR Site was most concentrated along and adjacent to the Columbia River valley. The soil data collected by the Washington Department of Ecology in 2012 documented maximum surface soil lead and arsenic concentrations of 1,920 and 56 mg/kg, respectively, from minimally disturbed soils on non-residential properties. In addition to the Trail BC smelter, the smaller historic Le Roi Smelter operated in Northport

and was located approximately 7 air miles south of the U.S.-Canadian Border. Stack emissions from Le Roi represent a secondary, localized source of metals potentially impacting surface soils near Northport. Residents within incorporated Northport previously participated in interim risk reduction measures in 2004 and 2005 as part of an interim emergency EPA Removal Action.

- The initial focus is on residential properties and tribal allotments located north of Northport and extending to the U.S. Canadian border, within the Columbia River Valley (Figure 1)
- Study boundaries will be reevaluated as results are available, including locations, frequency, and magnitude above PRGs
- Potential to segregate portions of each property for evaluation and remediation, depending upon size, access, known presence of imported fill, historical activities such as tilling, topography, and other site features will inform decision unit design.
- The target particle size is <150 micrometers representative of dermal adherence as a proxy for inadvertent soil ingestion (Ruby and Lowney 2012).
- Samples will be collected during a limited seasonal period when climatic conditions would likely exclude the presence of snow on the ground (typically April through September) or frozen ground.

5. Develop the analytic approach

Samples will be collected following an Incremental Composite Sampling designs from decision units (DUs) whose areal extent will be defined by the specific estimated exposure areas to be understood and investigated at each sampled residential property. Thus, a residential parcel may involve the establishment of one or more decision units depending on the size, features and usage patterns associated with the property.

Each incremental sample should consist of a minimum of 30 increments. The increments for each sample should be collected using a systematic grid to provide uniform spatial coverage (Interstate Technology & Regulatory Council 2012). Driplines should be avoided to reduce the likelihood of sampling soil contaminated by lead-based paint. TAL metals and lead bioaccessability will be measured. TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc http://www.epa.gov/superfund/programs/clp/ismtarget.htm.

6. Specify performance or acceptance criteria

This will be detailed in the sampling plan.

7. Develop the detailed plan for obtaining data

This will be detailed in the sampling plan.

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